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**NEW SPECIES OF FROGS, *CENTROLENELLA*,
FROM THE PACIFIC VERSANT OF ECUADOR
AND SOUTHERN COLOMBIA**

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During the past two decades field parties from The University of Kansas have been surveying the anuran fauna of the Pacific slopes of the Andes in southern Colombia and Ecuador. Earlier collections of centrolenid frogs from Ecuador formed the basis for a synopsis of the members of that family in Ecuador by Lynch and Duellman (1973). Subsequently, four more new taxa were named by Duellman (1980, 1981), and one was named by Flores (1985). Other unnamed taxa have accumulated during the past decade. Collections made by the junior author at La Planada in Colombia contained representatives of these new taxa. Her collections provided the impetus to prepare descriptions of the species named herein.

In addition to describing three new species, we take this opportunity to present a review of the geographic and altitudinal distribution of the species of centrolenids on the Pacific versant of Ecuador and southern Colombia, north to Departamento Valle del Cauca.

SYSTEMATICS

At present, the recognition of species groups in *Centrolenella* (fide Savage, 1967) is strictly phenetic. As noted by Lynch and Duellman (1973)

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and Cannatella and Duellman (1982), many South American species do not fit into Savage's groups, which were based on characters of Central American taxa. Consequently, we offer no suggestions about the relationships of the new species. The format for the following diagnoses and descriptions follows those of Lynch and Duellman (1973), Duellman (1981), and Cannatella and Duellman (1982).

Centrolenella ballux new species
(Fig. 1)

Holotype.—KU 164725, an adult male, from 14 km (by road) west of Chiriboga (00°18'S, 78°49'W), 1960 m, Provincia de Pichincha, Ecuador, one of a series collected on 8 May 1975 by William E. Duellman, John E. Simmons, and Linda Trueb.

Paratypes.—KU 164726–32 collected with the holotype; KU 164733 from Quebrada Zapadores, 5 km (by road) east-southeast of Chiriboga, 2010 m, Provincia de Pichincha, obtained on 11 May 1975 by William E. Duellman; IND-AN 1532, 1708, 1717–26 from Reserva La Planada, 7 km (by road) south of Chucunés, 1780 m, Departamento de Nariño, Colombia, collected April–June 1986 by Patricia A. Burrowes; KU 200272–77 from the same locality, collected by Patricia A. Burrowes and William E. Duellman on 28–30 March 1984.

Diagnosis.—(1) Vomerine teeth absent; (2) bones green; (3) parietal peritoneum white; visceral peritoneum clear; (4) color in life, dark lime green with golden yellow flecks; in preservative, lavender with cream flecks; (5) modal webbing between outer fingers III²/₂—2IV; (6) modal webbing on foot I2—2III1—2III1—2IV²/₂—1V; (7) snout bluntly rounded in dorsal view and in profile; (8) dorsal skin smooth; (9) arms and legs lacking tubercles and dermal folds; (10) humeral spine present; (11) lower four-fifths of tympanum visible, oriented dorsolaterally with slight posterior inclination.

No other species of *Centrolenella* on the Pacific versant is green with golden yellow flecks and no black dots. The combination of pale flecks and dark dots occurs in (1) *C. peristicta*, which has a row of tubercles along the ventrolateral edge of the forearm and tarsus, (2) *C. lynchi*, which has a low ulnar fold and finely spiculate dorsal skin, and (3) some individuals of *C. prosoblepon*, a larger species with vomerine teeth.

Description.—Head slightly wider than body; width of head 34.4–39.6 (\bar{x} =37.0, n =28) percent of snout-vent length; snout moderately short, bluntly rounded in dorsal view and in profile; canthus rounded; loreal region barely concave; lips not flared; nostrils two-thirds of the distance from eyes to tip of snout, barely protuberant, directed anterolaterally; internarial area flat. Eye moderately large, directed anterolaterally; supratympanic fold absent; lower

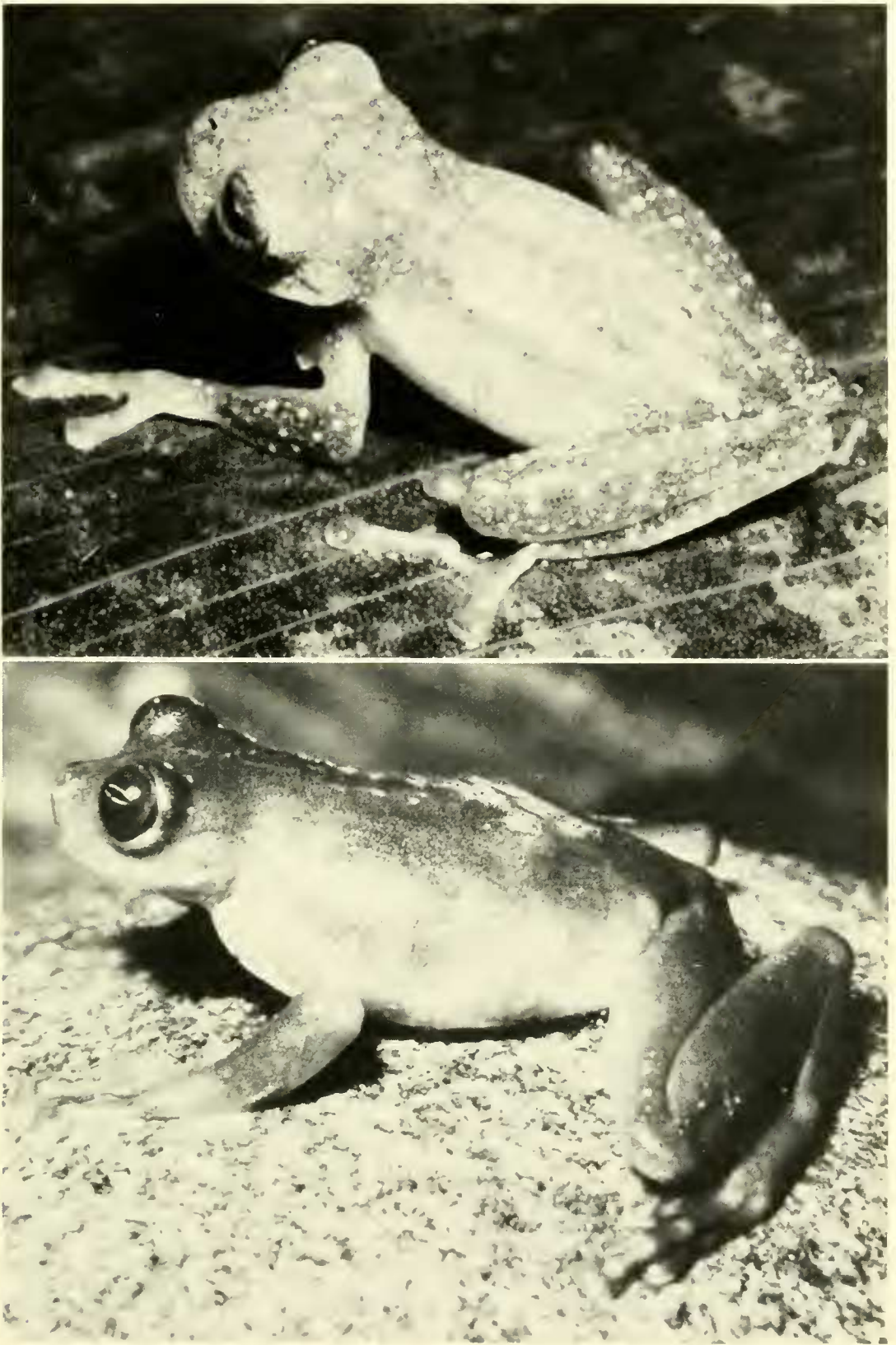


Fig. 1. Top. Holotype of *Centrolenella ballux*, KU 164725, male, 21.3 mm SVL. Bottom. Paratype of *Centrolenella orejuela*, IND-AN 1520, female, 29.6 mm SVL.

four-fifths of tympanum visible, oriented dorsolaterally with slight posterior inclination. Vomerine odontophores absent; vocal slits extending from mid-lateral base of tongue to angles of jaws.

Humeral spine large, blunt, at 45° angle to humerus; ulnar fold and tubercles absent; first finger shorter than second; fourth finger longer than second; lateral fringes absent on fingers; webbing absent between first and second fingers, vestigial between second and third; webbing formula for outer fingers $\text{III}(2^+ - 2^{1/2}) - (2 - 2^+)\text{IV}$; discs broadly elliptical; subarticular tubercles small, subconical, simple; palmar tubercle rectangular, simple; nuptial excrescences absent. Hind limbs slender; length of tibia 56.3–64.5 ($\bar{x}=60.4$, $n=28$) percent of snout-vent length; tarsal folds and tubercles absent; inner metatarsal tubercle small, elliptical; outer metatarsal tubercle absent; subarticular tubercles small, subconical; supernumerary tubercles absent; feet about three-fifths webbed; webbing formula $\text{I}2 - (2 - 2^+)\text{II}(1 - 1^{1/2}) - (2 - 2^+)\text{III}(1 - 1^{1/2}) - (2 - 2^+)\text{IV}(2 - 2^{1/2}) - (1 - 1^+)\text{V}$; discs on toes slightly smaller than those on fingers.

Skin on dorsal surfaces smooth; skin on belly and proximal posteroventral surfaces of thighs granular; other ventral surfaces smooth; anal opening directed posteriorly at upper level of thighs; anal folds and tubercles absent.

Color in preservative: Dorsal surfaces of head, body, forearms, thighs, shanks, and tarsi lavender with small cream flecks; hands, feet, margin of upper lip, and ventral surfaces cream.

Color in life: Dorsum dark lime green with minute pale gold-white flecks that are most numerous on the hind limbs; tips of digits yellowish green; venter translucent; parietal peritoneum creamy white; visceral peritoneum clear; heart not visible; bones green; iris bronze-copper with fine black reticulations.

Measurements: Ranges of variation in mm (mean \pm 1 standard deviation) for 25 males are: snout-vent length 19.2–22.2 mm (20.6 ± 0.911), tibia length 11.5–13.2 (12.4 ± 0.432), foot length 9.5–11.4 (10.3 ± 0.562), head width 7.2–8.3 (7.6 ± 0.264), head length 6.5–7.5 (6.9 ± 0.268). Ranges in mm (mean) for three females are: snout-vent length 21.0–23.3 (21.9), tibia length 12.8–14.1 (13.2), foot length 11.2–11.6 (11.3), head width 7.8–8.2 (7.9), head length 7.0–7.7 (7.4).

Distribution.—*Centrolenella ballux* is known from three localities in humid upper montane forest at elevations of 1700–2010 m on the Pacific versant of southern Colombia (Departamento de Nariño) and northern Ecuador (Provincia de Pichincha).

Ecology and behavior.—All individuals were found at night on the upper surfaces of leaves of bushes and small trees 0.5–2.0 m above small streams, or on ferns over roadside ditches. The call is a short, high-pitched trill. One male (IND-AN 1725) was on a leaf 5 cm below another leaf on which there was a clutch of 18 eggs having clear jelly.

Etymology.—The specific name is Latin; it means “gold dust” and is used in reference to the minute gold flecks on the dorsum.

Centrolenella orejuela new species
(Fig. 1)

Holotype.—KU 145081, an adult female, from between El Tambo and La Costa, 800 m, Departamento de Cauca, Colombia, obtained on 17 August 1937 by Kjell von Schneidern.

Paratypes.—KU 145080, an adult female from the type locality; IND-AN 1520–21, adult males from Pialapí, 1250 m, Departamento de Nariño, Colombia, collected on 20 May 1986, by Patricia A. Burrowes; LP 248, also from Pialapí, obtained on 31 October 1984 by Jorge E. Orejuela.

Diagnosis.—(1) Vomerine teeth present; (2) bones pale green; (3) parietal peritoneum white; visceral peritoneum white; (4) color in life, uniform dark green dorsally; in preservative, dull gray; (5) modal webbing on hand $\text{II}1\frac{1}{2}$ — $3\text{III}1\frac{1}{2}$ — IV ; (6) modal webbing on foot II — $1\text{II}1$ — $1\text{III}1$ — 1VI — 1V ; (7) snout truncate in dorsal view and in profile; (8) dorsal skin smooth; (9) arms and legs lacking tubercles and dermal folds; (10) humeral spine absent; (11) lower four-fifths of tympanum visible, oriented dorsolaterally with slight posterior inclination.

The only other large, uniformly green centrolenids on the Pacific versant in South America and in Central America are *C. ilex* and *C. prasina*. In the former, the visceral peritoneum is clear, the head is flat and broad, and the limbs are slender, as opposed to a deeper and proportionately narrower head and more robust limbs in *C. orejuela*. *Centrolenella prasina* differs in being larger (males 33.0–34.5 mm) and in having much less webbing on the hands and feet.

Description.—Head as broad as body, slightly wider than long; width of head 35.8–38.2 ($\bar{x}=36.7$, $n=6$) percent of snout-vent length; snout truncate in dorsal view and in profile; canthus rounded; loreal region concave; lips not flared; nostrils four-fifths of the distance from eyes to tip of snout, slightly protuberant, directed dorsolaterally; internarial area slightly depressed. Eye moderately large, directed anterolaterally; supratympanic fold weak, curved posteroventrally from eye; lower four-fifths of tympanum visible, oriented dorsolaterally with slight posterior inclination. Dentigerous processes of vomers transverse between elliptical choanae, narrowly separated medially, each bearing 2–5 teeth; vocal slits extending from midlateral base of tongue to angles of jaws.

Humeral spine absent; ulnar fold and tubercles absent; first finger barely shorter than second; fourth finger longer than second; lateral fringes present on fingers; webbing absent between first and second fingers; webbing formula for outer fingers $\text{II}(1^+-1\frac{1}{2})$ — $(3^--3)\text{III}(1^+-1\frac{1}{2})$ — $(1-1^+)\text{IV}$; discs

broad, truncate; subarticular tubercles moderately large, round, simple; supernumerary tubercles minute, conical, on basal segments of Digits II–IV; palmar tubercle bifid; nuptial excrescences absent. Hind limbs moderately robust; length of tibia 56.6–64.3 (\bar{x} =61.2, n =6) percent of snout-vent length; tarsal folds and tubercles present; dermal fold present on outer edge of fifth toe; inner metatarsal tubercle small, elliptical; outer metatarsal tubercle absent; subarticular tubercles small, round; supernumerary tubercles minute, on proximal segments of all toes; toes webbed to bases of discs; discs slightly smaller than those on fingers.

Skin on dorsal surfaces smooth; skin on belly and proximal posteroventral surfaces of thighs granular; other ventral surfaces smooth; anal opening directed posteriorly at upper level of thighs; anal folds and tubercles absent.

Color in preservative: Dorsum, including hands, feet, and webbing dull gray; venter cream.

Color in life: Dorsum uniform dark olive green; venter translucent with greenish tint; parietal and visceral peritonea creamy white with golden suffusion (posterior part of visceral peritoneum clear in IND-AN 1520); heart not visible; bones green; iris dark gray with yellow ring around pupil.

Measurements: Ranges of variation (mm) with means in parentheses for three males, followed by those of two females, are: snout-vent length 27.3–28.3 (27.9) 29.6–33.7 (31.6), tibia length 16.3–18.2 (17.5) 17.9–19.1 (18.5), foot length 14.2–15.9 (15.0) 15.6–17.2 (16.4), head width 9.9–10.8 (10.3) 10.6–12.3 (11.4), head length 9.4–10.1 (9.6) 9.7–10.7 (10.2).

Distribution.—*Centrolenella orejuela* is known from two localities in lower humid montane forest at elevations of 800 and 1250 m on the Pacific versant of southern Colombia.

Ecology and behavior.—At Pialapí males were found at night on rocks along a steep stream bank or on rocks within the stream; all were in the spray zone of cascades.

Etymology.—The specific name is a noun in apposition for the Orejuela family (Jorge, Anamaría, and Tomás), who reside at, and administer, the Reserva La Planada, Colombia.

Centrolenella scirtetes new species
(Fig. 2)

Holotype.—KU 202720, an adult male, from 1.4 km (by road) southwest of Tandayapa (00°07'S, 78°40'W), 1820 m, Provincia de Pichincha, Ecuador, obtained on 2 April 1984 by David M. Hillis.

Paratypes.—IND-AN 1405 and 1533, adult females, from Reserva La Planada, 7 km (by road) south of Chucunés, 1780 m, Departamento de Nariño, Colombia, collected 2 May and 3 June 1986 by Patricia A. Burrowes.

Diagnosis.—(1) Vomerine odontophores absent; (2) bones green; (3)



Fig. 2. Paratype of *Centrolenella scirtetes*, IND-AN 1533, female, 26.1 mm SVL.

parietal peritoneum white; visceral peritoneum clear; (4) color in life, green with black dots; color in preservative, pale lavender with dark dots; (5) modal webbing on hand II2—3III3—2IV; (6) modal webbing on foot I1—2II1—2III1—2IV2—1V; (7) snout truncate in dorsal view, bluntly rounded in profile; (8) skin on dorsum finely spiculate in male, smooth in females; (9) arms and legs lacking tubercles and dermal folds; (10) humeral spine present in male; (11) lower four-fifths of tympanum visible, directed posterolaterally with slight dorsal inclination.

The combination of the absence of vomerine teeth and presence of humeral spines and dark dots on the dorsum distinguish *C. scirtetes* from all other centrolenids on the Pacific versant of South America except *C. peristicta*. The latter is a smaller species (males 18.7–20.6, females 20.4–21.0 mm snout-vent length) with a rounded snout in dorsal view, shagreened dorsal skin, row of low tubercles on the ventrolateral edges of the forearm and tarsus, and the entire tympanum visible.

Description.—Head as wide as body, broader than long; width of head 37.2–38.3 ($\bar{x}=37.9$, $n=3$) percent of snout-vent length; snout short, truncate in dorsal view, bluntly rounded in profile; canthus rounded; loreal region barely concave; lips not flared; nostrils four-fifths distance from eyes to tip of snout, protuberant, directed dorsolaterally; internarial area slightly depressed. Eye moderately large, directed anterolaterally; supratympanic fold absent; lower four-fifths of tympanum visible, directed posterolaterally with

slight dorsal inclination. Vomerine odontophores absent; vocal slits extending from midlateral base of tongue to angles of jaws.

Humeral spine moderately large, blunt, at 45° to humerus; ulnar fold and tubercles absent; first and second fingers equal in length; fourth finger much longer than second; lateral fringes absent on fingers; webbing absent between first and second fingers; webbing formula $\text{II}2\text{—}3\text{III}3\text{—}2\text{IV}$; discs broad, truncate; subarticular tubercles, small, round, simple; palmar tubercle bifid; nuptial excrescences absent. Hind limbs moderately slender; tibia length 55.6–60.1 ($\bar{x}=58.0$, $n=3$) percent of snout-vent length; tarsal folds and tubercles absent; inner metatarsal tubercle small, elliptical; outer metatarsal tubercle absent; subarticular tubercles small, round; supernumerary tubercles minute, subconical, on proximal segments of all toes; feet about two-thirds webbed; webbing formula $\text{I}1\text{—}2\text{II}(1\text{—}1^+)\text{—}2\text{III}(1\text{—}1^+)\text{—}2\text{IV}2\text{—}1\text{V}$; discs on toes slightly smaller than those on fingers.

Skin on dorsal surfaces in females smooth, finely spiculate (especially on upper lip and in tympanic region) in male; skin on belly and proximal posteroventral surfaces of thighs granular; other ventral surfaces smooth; anal opening directed posteriorly at upper level of thighs; two pairs of tubercles on proximal surfaces of thighs below anal opening.

Color in preservative: Dorsal surfaces of head, body, forearms, thighs, shanks and tarsi pale lavender with black dots (and white spicules in male); hands, feet, and ventral surfaces cream.

Color in life: Dorsum pale lime green with black flecks; digits green with orange-yellow discs; venter translucent with a greenish tint; parietal peritoneum creamy white; visceral peritoneum clear; heart not visible; bones pale green; iris creamy bronze with a copper suffusion and fine black reticulations.

Measurements: The measurements (in mm) for the one male and two females are, respectively: snout-vent length 24.4, 25.8, 26.1; tibia length 14.4, 14.5, 15.5; foot length 11.3, 11.6, 12.4; head width 9.3, 9.7, 9.9; head length 8.5, 8.6, 8.8.

Distribution.—*Centrolenella scirtetes* is known only from two localities at elevations of 1780 and 1820 m in the humid upper montane forest on the Pacific versant of northern Ecuador and extreme southern Colombia.

Ecology and behavior.—All individuals were found at night on large leaves of Araceae or palm fronds overhanging small streams. The two females contain dark green eggs.

Etymology.—The specific name is derived from the Greek *skirtetes* and is used as a noun in apposition. The name means leaper and is used in reference to the jumping abilities of *Centrolenella*, and not coincidentally, to the same abilities of the collector of the holotype, David M. Hillis.

DISCUSSION

We are aware of 13 other species of centrolenid frogs from the Pacific slopes of Ecuador and southern Colombia, northward to include the Departamento Valle del Cauca. Of these, three species of *Centrolenella* are known only from southern Colombia. The Colombian taxa include a species from the Anchicayá Valley in Departamento Valle del Cauca being named by Charles W. Myers and another species referred to *C. illex* by Lynch and Duellman (1973). However, the latter species actually may represent another unnamed species (C. W. Myers, pers. comm.).

Centrolenids usually are restricted to the vicinity of streams having at least moderate gradients. An exception is *C. buckleyi*, which at some high-Andean sites occurs in the vicinity of ponds and drainage ditches. High-gradient streams are most numerous on the slopes of the Andes, where there is an altitudinal gradient in temperature and vegetation. Using the bioclimatic and ecological maps of Colombia (IGAC, 1977) and Ecuador (Cañadas, 1983) based on the Holdridge (1967) system, we recognize four major vegetation types inhabited by centrolenids on the Pacific versant of Ecuador and southern Colombia.

1. Lowland rainforest (bosque muy húmedo tropical and bosque muy húmedo premontano) extending from sea level to elevations of about 600 m.
2. Humid lower montane forest (bosque muy húmedo montano bajo) ranging from about 600 to 1500 m.
3. Humid upper montane forest (bosque muy húmedo montano) extending from about 1500 to 2500 m.
4. Páramo and subparamo (páramo subalpino), the supra-treeline vegetation zones above 2500 m.

The distribution of centrolenids with respect to these vegetation zones (Fig. 3) reveals that species richness is greatest in the humid montane forests—12 species are in the upper montane forest and 14 species in the lower montane forest. Seven of these species occur in both vegetation zones. Five species occur in the lowland rainforest; of these, four also range into the lower montane forest and two into the upper montane forest. Only one species, *C. buckleyi*, occurs in the páramo and subparamo.

The greatest diversity of centrolenids in the montane forests probably reflects an abundance of high-gradient streams there, in contrast to the lowland tropical rainforest and the páramo. Also, montane forests are characterized by high humidity throughout the year. This is important to the survival of centrolenid eggs, which are deposited on vegetation above the water [rocks in spray zones of waterfalls in the case of *Centrolene geckoideum* (Lynch et al., 1983)].

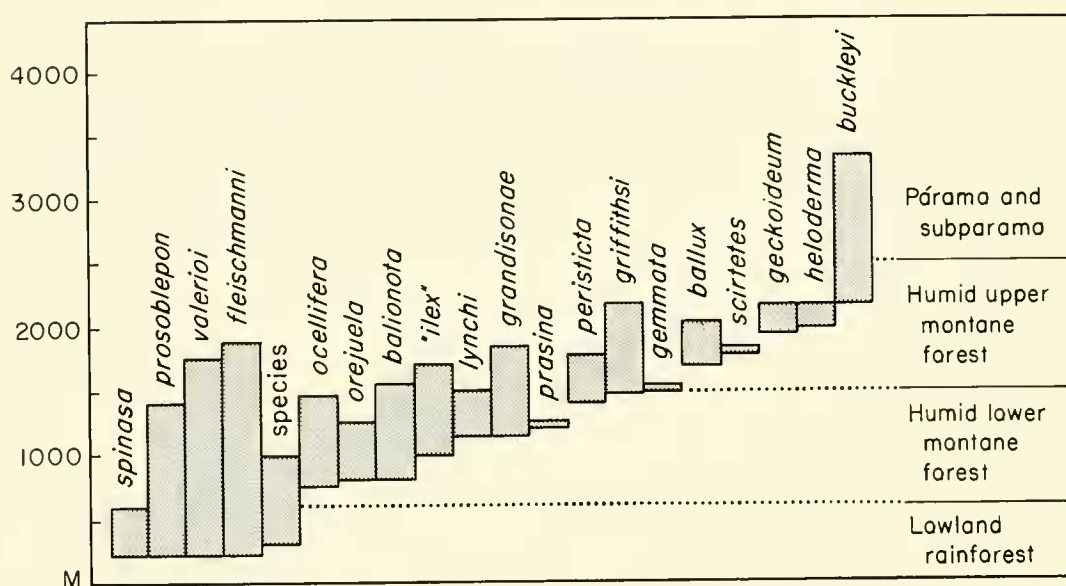


Fig. 3. Altitudinal distributions of species of centrolenid frogs on the Pacific versant of southern Colombia and Ecuador.

Four of the species inhabiting the lowland tropical rainforest have extensive geographical distributions. All four reach the southern limits of their distributions in western Ecuador but range northward into Middle America—*C. spinosa* and *valerioi* to Costa Rica, *C. prosoblepon* to Nicaragua, and *C. fleischmanni* to southern Mexico. Moreover, the one species in the páramos and subparamos, *C. buckleyi*, ranges in the high Andes from the Cordillera de Mérida in Venezuela to southern Ecuador. In contrast, those species restricted to the montane forests have rather limited distributions. None of the species in these forests in Ecuador and southern Colombia is known from farther north in Colombia, and none occurs on the eastern slopes of the Andes.

At many sites in humid montane forests, numerous species of centrolenids occur in sympatry (Fig. 4; Table 1). Commonly, as many as three or four species can be seen and/or heard while standing at one place in a montane stream. The largest reported sympatric assemblage is seven species at Tandapi at 1460 m in humid lower montane forest, and at La Planada at 1780 m in humid upper montane forest. By contrast, the largest assemblage in the lowland rainforest is four species at Río Palenque at 220 m. Sympatric species have distinctive advertisement calls; at least some species also have different calling and ovipositional sites, and activity zones (heights above streams).

Coexisting in most of the streams where centrolenids occur are species of the *Hyla bogotensis* group—*H. alytolylax* in the lower and upper montane forests and *H. palmeri* in the lowland rainforest and lower montane forest (Duellman, 1972; Myers and Duellman, 1982). These nocturnal frogs also call from vegetation over streams and occur syntopically with centrolenids.

The tadpoles of centrolenids characteristically bury themselves in gravel

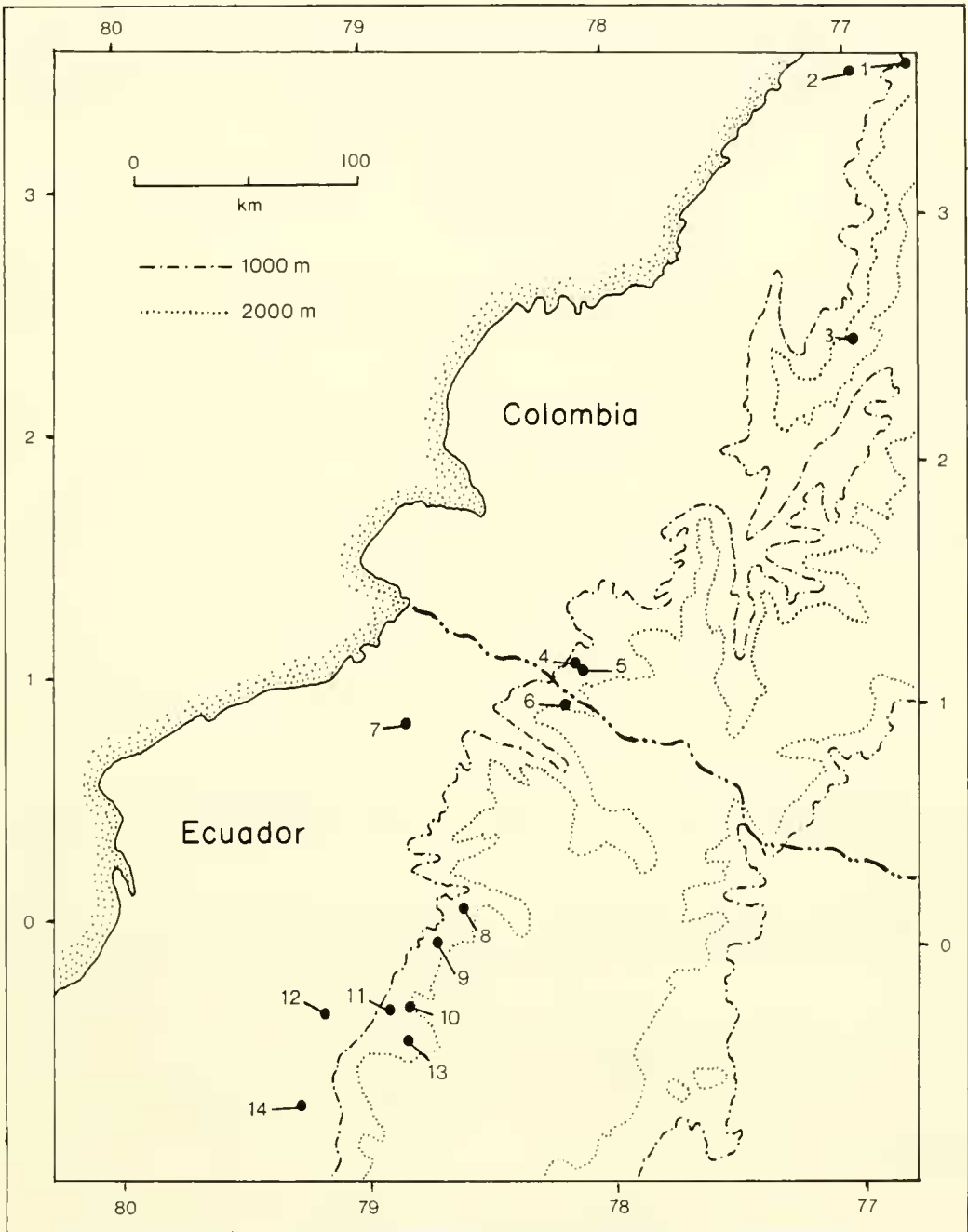


Fig. 4. Map of southwestern Colombia and northwestern Ecuador. Numbers correspond to the following localities arranged from north to south: Colombia: 1. Río Calima, 2. Río Anchicayá, 3. El Tambo, 4. Pialapí, 5. La Planada. Ecuador: 6. Maldonado, 7. San Miguel, 8. Tandayapa, 9. Mindo, 10. Chiriboga, 11. Dos Ríos, 12. Santo Domingo de los Colorados, 13. Tandapi, 14. Centro Científico Río Palenque.

or detritus on the bottom, or at the edges, of streams at places of moderate gradients. In contrast, the much larger tadpoles of the *Hyla bogotensis* group adhere to the upper, or leeward, sides of stones in flowing water. Two other genera of frogs (*Colostethus* and *Atelopus*) are abundant along streams in the montane forests; *Colostethus* are diurnal, and *Atelopus* are diurnal and

TABLE 1.—Distribution of species of *Centrolenella* and *Centrolene geckoideum* among nine sites on the Pacific versant of southern Colombia and Ecuador. 1 = Río Calima, 2 = La Planada, 3 = Maldonado, 4 = Tandayapa, 5 = Mindo, 6 = Dos Ríos, 7 = Chiriboga, 8 = Tandapi, 9 = Río Palenque.

Species	1	2	3	4	5	6	7	8	9
<i>C. balionota</i>	-	-	-	-	+	-	-	-	-
<i>C. ballux</i>	-	+	-	-	-	-	+	-	-
<i>C. fleischmanni</i>	-	-	+	-	-	-	-	+	+
<i>C. geckoideum</i>	-	-	-	+	-	-	+	-	-
<i>C. grandisonae</i>	+	+	+	-	+	+	-	+	-
<i>C. griffithsi</i>	-	+	-	+	+	-	+	+	-
<i>C. heloderma</i>	-	-	-	+	-	-	+	-	-
<i>C. lynchi</i>	-	-	-	-	-	+	-	+	-
<i>C. ocellifera</i>	-	-	-	-	-	-	-	+	-
<i>C. peristicta</i>	-	+	+	-	-	-	-	+	-
<i>C. prasina</i>	+	-	-	-	-	-	-	-	-
<i>C. prosoblepon</i>	+	-	+	-	-	+	-	-	+
<i>C. scirtetes</i>	-	+	-	+	-	-	-	-	-
<i>C. spinosa</i>	-	-	-	-	-	-	-	-	+
<i>C. valerioi</i>	+	+	+	-	-	+	-	+	+

nocturnal. The tadpoles of *Colostethus* usually are in pools in the streams, whereas the tadpoles of *Atelopus* adhere to, or are concealed below, stones in the streams.

Although additional species of centrolenids probably will be found on the Pacific versant of Ecuador and southern Colombia, the existing data are sufficient to provide a general picture of the species diversity, altitudinal ranges, and geographic distribution of the group. Furthermore, existing knowledge of sets of sympatric species suggests that these frogs could be excellent subjects for future studies of communities in the humid montane forests.

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RESUMEN

Se describen tres especies nuevas de *Centrolenella* de la vertiente Pacífica de Ecuador y el sur de Colombia. *Centrolenella ballux* y *scirtetes* son especies pequeñas de actividad nocturna en vegetación que cuelga sobre las quebradas en el bosque húmedo montano alto a elevaciones de mas de 1700 m. *Centrolenella orejuela* es una especie grande, activa sobre rocas en quebradas a elevaciones entre 800 y 1250 m en el bosque húmedo montano bajo.

Se conocen 20 especies de centrolenidos de la vertiente Pacífica de Ecuador y el sur de Colombia; de estas, 14 están restringidas al bosque húmedo montano a elevaciones desde 600 a 2500 m. Sin embargo, cuatro especies que ocurren en tierras bajas también se extienden hasta el bosque montano. Una especie, *C. buckleyi*, está restringida al páramo y subpáramo a elevaciones sobre 2500 m, pero tiene una distribución amplia desde Venezuela hasta el sur de Ecuador. Cuatro de cinco especies del bosque pluvial tropical extienden su rango hacia el norte hasta Centroamérica. Por lo contrario, las especies del bosque húmedo montano tienen distribuciones geográficas restringidas. El grupo mas grande de especies simpátricas consiste de siete especies en Tandapi, Ecuador, y seis en La Planada, Colombia. El grupo mas grande de especies en el bosque pluvial tropical es de cuatro especies en el Río Palenque, Ecuador.

LITERATURE CITED

- Cañadas Cruz, L. 1983. El mapa bioclimatico y ecologico del Ecuador. Minis. Agri. Ganad., Quito.
- Cannatella, D. C. and W. E. Duellman. 1982. Two new species of *Centrolenella*, with a brief review of the genus in Perú and Bolivia. *Herpetologica* 38:380-388.
- Duellman, W. E. 1972. A review of the neotropical frogs of the *Hyla bogotensis* group. *Occas. Pap. Mus. Nat. Hist. Univ. Kansas* 11:1-31.
- Duellman, W. E. 1980. The identity of *Centrolenella grandisonae* Cochran and Goin (Anura: Centrolenidae). *Trans. Kansas Acad. Sci.* 83:26-32.
- Duellman, W. E. 1981. Three new species of centrolenid frogs from the Pacific versant of Ecuador and Colombia. *Occas. Pap. Mus. Nat. Hist. Univ. Kansas* 88:1-9.
- Flores, G. 1985. A new *Centrolenella* (Anura) from Ecuador, with comments on nuptial pads and prepollical spines in *Centrolenella*. *J. Herpetol.* 19:313-320.
- Holdridge, L. R. 1967. Life zone ecology. *Trop. Sci. Cent.*, San José.
- IGAC. 1977. Zonas de vida o formaciones vegetales de Colombia. *Inst. Geog. "Agustin Codazzi"* 13(11):1-238.

- Lynch, J. D. and W. E. Duellman. 1973. A review of the centrolenid frogs of Ecuador, with descriptions of new species. *Occas. Pap. Mus. Nat. Hist. Univ. Kansas* 16:1-66.
- Lynch, J. D., P. M. Ruíz and J. V. Rueda. 1983. Notes on the distribution and reproductive biology of *Centrolene geckoideum* Jimenez de la Espada in Colombia and Ecuador (Amphibia: Centrolenidae). *Stud. Neotrop. Fauna Envir.* 18:239-243.
- Myers, C. W. and W. E. Duellman. 1982. A new species of *Hyla* from Cerro Colorado, and other tree frog records and geographical notes from western Panama, *Amer. Mus. Novit.* 1752:1-32.
- Savage, J. M. 1967. A new tree-frog (Centrolenidae) from Costa Rica. *Copeia* 1967:325-331.